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ABSTRACT

This paper discusses the benefits of the team approach to teaching mathematics to elementary children with visual impairments in inclusive settings and offers strategies for classroom teachers and team teaching. Strategies for classroom teachers include: (1) avoiding the use of words such as "this", "that", and "there", that will be meaningless to a student with blindness; (2) ensuring that descriptions of problems or techniques are worded carefully to avoid ambiguity; (3) speaking everything that is written on the chalkboard and spelling new words while they are being written; (4) providing transparencies and notes for the teacher of students with visual impairments to transcribe into braille for students to use at their desks; (5) when describing concepts through the use of everyday objects, choosing objects which a student with blindness is able to access readily and understand; (6) providing a print copy of textbooks and handouts to students with blindness to be used by a reader at home; (7) providing extra desk space for braille materials; (8) administering tests orally; (9) having a person who can read braille check mathematics assignments; and (10) forwarding assignments and answer keys to the teacher of students with visual impairments in advance. (CR)

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# Collaborative and Inclusive Strategies for Teaching Mathematics to Blind Children

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Collaborative and Inclusive Strategies for Teaching Mathematics to Blind Children

Inclusion

Inclusion in the regular classroom affords several benefits to students who have visual disabilities. First, it provides a continuity of instruction for the student, with fewer interruptions in the day. The student can readily compare his or her skill level and achievement to that of his or her peers. Instruction in compensatory skills, such as the use of adaptations or assistive technology, is more effective and generalized when taught within the regular curriculum, in regular classroom activities. In addition, when a student attends his or her neighborhood school, he or she is more likely to be a part of the greater community, participating in community activities where functional application of skills will take place.

When a student is enrolled in mainstream classes, both special and general educators have increased opportunities to observe academic and social progress in order to make valid comparisons with peers, ensuring that the student's development is age- and ability-appropriate. It is an effective approach for determining if the student is using time and assistive devices appropriately, and whether he or she is using effective notetaking strategies. The opportunity exists for teachers to combine expertise in order to increase the effectiveness of their instruction. Inclusion eliminates the problem of lack of quality (or perceived lack of quality) of mathematics instruction from a special education teacher, and reduces the difficulties created when a mathematics teacher is not versed in accommodations and adaptations for blind students. At the elementary level, inclusion also eliminates the inconvenience, to the classroom teacher, of having

to send the student out of the classroom for mathematics instruction at important times of the day. This is particularly important when the schedule changes and the student is absent during another essential class activity in order to receive instruction in mathematics.

The Transdisciplinary Model

Since the inception of the Individuals with Disabilities Education Act (IDEA), which mandates placement in the least restrictive environment, inclusion (or the regular education initiative) has become the predominant model in special education placement. Effective educational programming in an inclusive setting requires intensive and ongoing collaboration of all members of a student's educational team. There is movement away from the traditional multi-disciplinary model, where experts work independently (and usually on a "pull-out" basis) on assessment, development of separate goals, and instruction related to their particular area of expertise, meeting occasionally to report progress to the team.

Advantages of the team approach.

Research indicates that the transdisciplinary teaming model, with integrated special services occurring during the regular program in the regular classroom, is the most effective way of delivering instruction (Woodward & Baxter, 1997). In this model, all team members work collaboratively on the same goals, sharing responsibility for assessment, planning, sharing of information, problem-solving, and decision-making. Specialists in each area are responsible for reporting and monitoring progress in goals most related to their area of specialization, as well as "role release", or training of other

team members in the best practices of their specialized area as they apply to an individual student.

Implementation of the team approach.

Implementation of the transdisciplinary teaming model requires training in collaboration and team teaching techniques. Regularly scheduled, frequent (at least weekly) time for planning and reviewing progress, airing problems, and discussing different approaches and instructional strategies is essential. There is a need to teach strategically, providing support groups or individualized additional instruction for students who need more time to practice facts, for example, or who could benefit from enrichment or an extension of the curriculum. Meeting individual needs for methods or materials based on their particular learning style and/or strengths will help students build successful experiences in mathematics, and improve their confidence in mathematics-related skills.

In the ideal teaming situation, teachers share in planning, presenting lessons, and checking assignments. It is essential that students (as well as teachers!) perceive both classroom and special educators as teachers, rather than one as a teacher, the other as a helper. The special educator and the teacher of mathematics share personal and professional strengths, and appreciation for each other's expertise. Both teachers assume responsibility for instruction for all students, including sharing success and frustrations, planning, evaluating, and problem solving. The teachers shift between direct and indirect support. This approach fosters the improvement of instruction by facilitating the team members' collaborative work using their strengths, by

encouraging joint efforts to solve problems, by promoting the generation of creative methods, by reducing professional isolation, by increasing understanding of the roles of different professionals, and by diminishing the stigma associated with special education (Pugach & Johnson, 1995).

Particularly in the middle school and in high school, the roles of the mathematics teacher and the special education teacher are well-defined. Mathematics teachers are the content specialists the special education teacher provides the knowledge and skill in adapting materials and teaching strategies and instruction in the Nemeth Code. Once a student masters the basic mathematical concepts, including Nemeth Code, then the mathematics teacher should teach the subject matter content and the teacher of visually impaired students is responsible for teaching any new braille code information, and transcribing materials into braille, raised line drawings, and tactile graphics. Each uses his or her particular expertise, working closely together to facilitate learning.

In high school, while co-planning and teaching may be impractical, it is vital that the special educator establish an ongoing arrangement for communication with the mathematics specialist. This may take the form of memos, telephone contact, regularly scheduled tutoring sessions, or perhaps assistance from the teacher of visually impaired students in the administration and evaluation of tests.

Advice for Classroom Teachers

Following are some generalizations which the teacher of visually impaired students should bring to the attention of the classroom mathematics teacher, to

facilitate meaningful class involvement and participation by the blind student:

- During a lecture, words such as "this", "that", and "there" will be meaningless to a blind student and should be avoided.
- Description of problems or techniques should be worded carefully to avoid ambiguity; a copy of the Handbook of Spoken Mathematics (Chang, 1983, included as Appendix B in Kapperman, Heinze, & Sticken, 1997) may be helpful.
- When writing on the chalkboard, speak everything that is written; be sure to describe labeling of a diagram drawn on the board, and spell new words while they are being written.
- Provide transparencies and notes from the chalkboard for the teacher of visually impaired students to transcribe into braille for the blind student to use at his or her desk. Ideally, these can be sent home in print and braille prior to a given lesson, so they can be previewed, then reviewed, by the student and his or her parent.
- When describing concepts through the use of everyday objects, be certain to choose objects which a blind student is able to readily access and understand. Items which can be explored tactually, in their entirety, such as hardware, toys, kitchen utensils, etc., will have meaning, whereas large and/or remote objects such as airplanes, elephants, clouds, etc., will be difficult to fully appreciate by a tactual learner.
- It is often helpful for a blind student to have a print copy of textbooks and handouts to be used by a reader at home.

- The blind student sometimes needs extra desk space, and a storage area for braille materials.
- If the sighted students are required to complete problems on the chalkboard, a classmate can write the work on the chalkboard as the blind student explains it aloud.
- Tests can be administered orally. Occasionally, an oral test may be given to the entire class. In some situations, it will be given to the blind student individually, outside of the regular classroom.
- Tests can also be recorded. Under these circumstances, the blind student can use headphones and remain in the classroom to take the test.
- Mathematics assignments should be checked daily by an individual who can read braille, to insure that the braille itself is accurate. Inkprint answer keys should be sent home so parents can check the student's homework; in some cases, braille and inkprint answer keys may be used.
- Assignments and answer keys need to be forwarded to the teacher of visually impaired students in advance.
- Instruct classroom teachers in the techniques for making simple adaptations, such as using a tracing wheel or Wikki Stix for graphs which are immediately available to the student.

Strategies for Team Teaching

Cooperation between grade level classroom teachers and special education personnel, including paraprofessionals, is necessary for inclusion in mathematics to

succeed. The use of small homogenous groups for instruction in at least one portion of a lesson enables the teachers to adjust content according to ability levels while implementing modifications or adaptations. The use of small group instruction also enhances student involvement and immediate feedback from the teacher. Using large, heterogeneous groups is usually effective for introducing a new concept or skill. Grouping decisions should always be viewed as temporary (dynamic, or contingent, or flexible grouping), depending on the nature of the lesson and individual needs of the students.

There are a variety of effective methods for co-teaching. Different strategies should be used for different circumstances, depending on which would be most effective for a particular lesson. Some of the possibilities include:

- Teachers each take responsibility for half the class and teach a concept or skill to mastery.
- One teacher provides guided practice, for the entire class, in a concept previously taught but not mastered, while the second teacher moves about the room providing individual assistance and monitoring individual performance.
- The teacher of visually impaired students works with an individual student, using adaptive techniques and materials during the regular lesson.
- One teacher demonstrates alternative teaching techniques for the other teacher.
- The teacher of visually impaired students provides related enrichment lessons or units.
- The teacher of visually impaired students assumes total responsibility for a

sub-group within the class.

- The teacher of visually impaired students provides instruction for all students in the use of peer tutors and partner learning techniques.
- The teacher of visually impaired students serves as tutor for groups of children having difficulty with a particular concept or skill.
- The teacher of visually impaired students can be responsible for a mathematics learning center in a primary level classroom.
- Both teachers assume responsibility for modification of the curriculum or assignments, if necessary, including quantity, simplification of format or instructions, or assessment procedures.
- Both teachers are involved in the development of the Individual Education Plan (IEP).
- Both teachers participate in conferences with parents.

Activities for Teaching in an Inclusive Setting

- Institute a mathematics "problem of the day", developed and graded by the teacher of visually impaired students. This will assist both teachers in monitoring the progress and skills of individual students relative to the rest of the class.
- Particular emphasis should be placed on teaching students to be self-advocates, articulating what a classroom teacher needs to do in order for the student to participate in learning. To encourage the development of skills in self-advocacy, the teacher of students with visual impairments can periodically develop a poorly-planned lesson, present it to the student, and role-play potential

strategies for soliciting appropriate information or assistance.

- In secondary level mathematics classes, teaching assistants can be trained in a protocol for spoken mathematics (see Chang, 1983 for an example), and to make "on-the-spot" tactile diagrams.
- In some large school districts, a high school mathematics teacher is assigned to a resource room for students with visual impairments for one period each day. The mathematics teacher provides individualized instruction in any of the mathematics courses in which the resource students are enrolled, while the teacher of visually impaired students provides adaptations.
- Enlist the assistance of the Orientation and Mobility Specialist to reinforce mathematics concepts in "real life" situations.

## Summary

The reformed standards in mathematics education include an emphasis on meaningful problem solving and multiple, effective strategies for solving problems rather than memorizing facts; and understanding of concepts and solving longer, more complex problems (Woodward & Baxter, 1997). These reforms may pose additional problems for special needs students who are included in the regular classroom, since they propose teaching concepts more quickly and in greater depth, with less repetition, and using real-life problems from other curricular areas which require multiple-step solutions.

It is necessary to devote considerable time to developing and practicing skills of pattern identification, number sense, estimation, and developing multiple solutions for

problems, while using an array of manipulatives and calculation tools. Rote skills need to be combined with challenging problems which apply the skills in order to prepare adequately for instruction in higher mathematics.

A thorough review of the literature reveals that achievement in mathematics among blind and severely visually disabled persons is, and always has been, extraordinarily low (Kapperman, 1974). The transdisciplinary approach to instruction in mathematics is an effective way to reduce or eliminate the barriers to achievement in mathematics, thereby improving access to many educational and vocational opportunities.

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